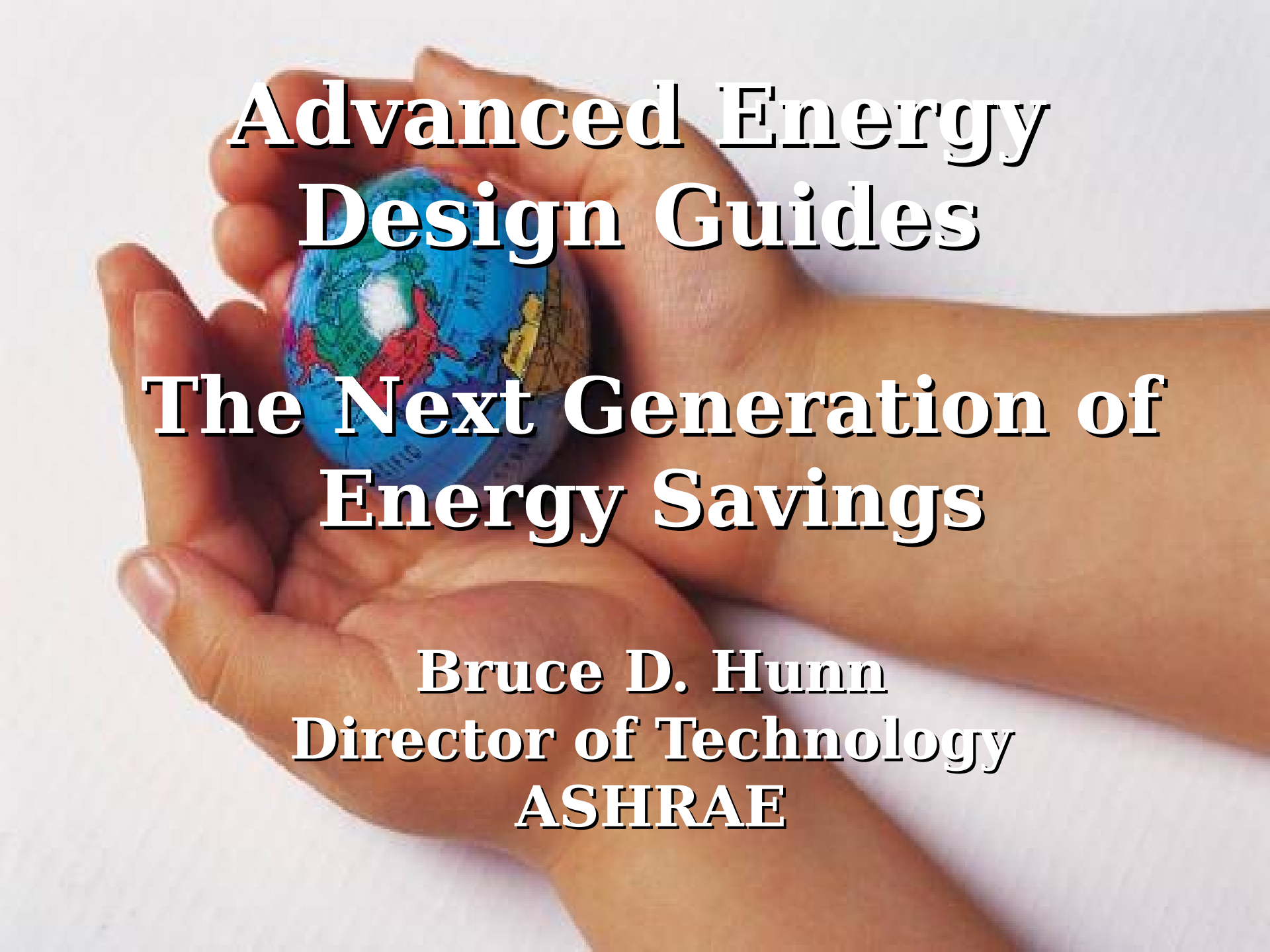
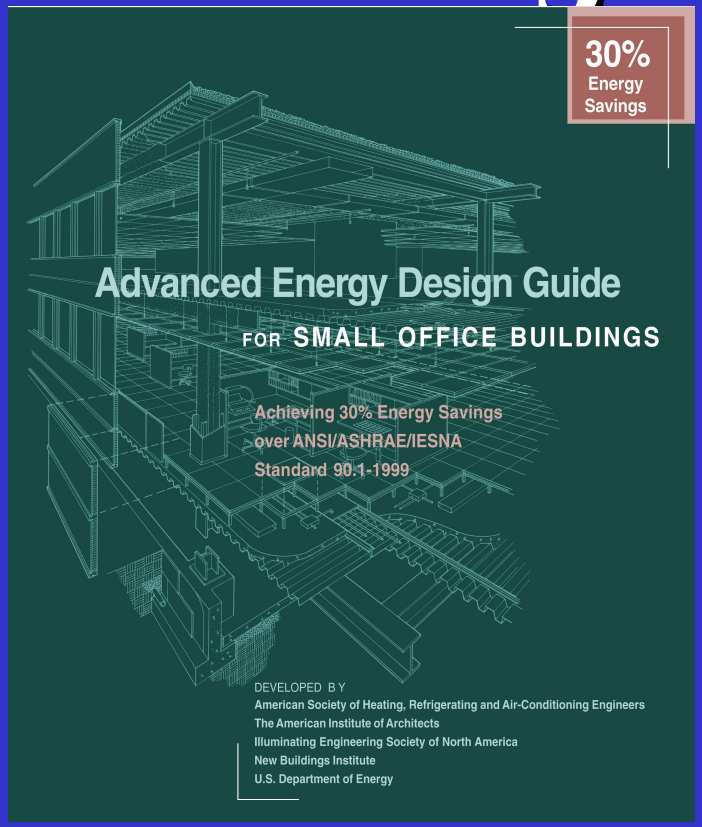


Advanced Energy Design Guides

The Next Generation of Energy Savings

Bruce D. Hunn
Director of Technology
ASHRAE

Advanced Energy Design Guide For Small Office Buildings



AEDG - SO

- 11 person steering group
  - Developed objectives & scope
  - Made policy decisions
- 13 person writing team
- Three levels of review

How the Guide Helps You

- Presents *a way, but not the only way* to build energy efficient buildings that use 30% energy savings when compared to Standard 90.1-1999
- Provides design strategies/choices through prescriptive recommendations using practical, off-the-shelf technology
- Target market: contractors, design/build firms and designers involved in building small offices
- LEED points: 4 E&A credits

Scope

- Building type and size – office buildings < 20K ft^2. Is the most prevalent building type in United States.

- Base criteria
  - 90.1-1999
  - Savings location specific, not national aggregate
  - Focus on air-side distribution using unitary equipment

What's In the Guide?

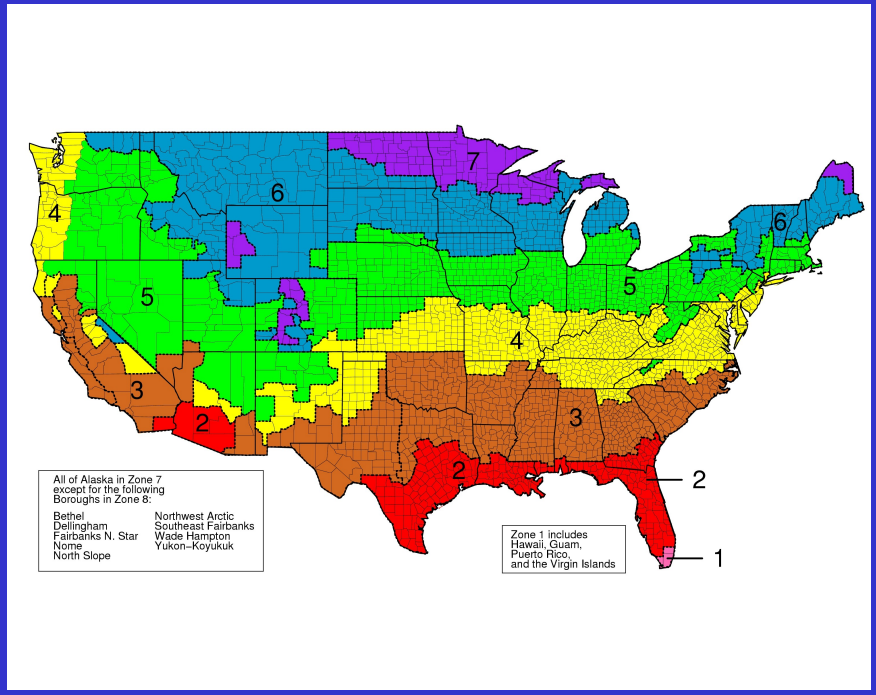
- Section 1 – Introduction
- Section 2 - Integrated design process to achieve energy savings *(how to integrate energy into the design of the building)*
- Section 3 - Recommendations by climate zone including example building designs *(the specifics)*
- Section 4 - How-to guidance for implementing recommendations *(helpful hints and cautions)*

Integrated Design Process to Achieve Energy Savings

- Narrative discussion of design and construction process that points out opportunities for energy savings in each phase
- Reference table to identify and select energy savings measures to meet major energy design goals

Recommendations Tables

- Given by climate zone
- Combined energy savings based on “systems approach” where all recommendations are used
- Recommendations based upon many DOE-2 simulations



Items Covered in Prescriptive Recommendations

- Roof
- Walls
- Floors
- Slabs
- Doors
- Vertical glazing
- Skylights
- Interior lighting
- HVAC
- Ventilation
- Ducts
- Service water heating

Recommendation Tables

Climate Zone 5 Recommendation Table

	Item	Component	Recommendation	How-To's in Chapter 4
Envelope	Roof	Insulation entirely above deck	R-20 c.i.	EN2, 17, 20-21
		Metal building	R-13 + R-19	EN3, 17, 20-21
		Attic and other	R-38	EN4, 17-18, 20-21
		Single rafter	R-38 + R-5 c.i.	EN5, 17, 20-21
		Surface reflectance/emittance	No recommendation	
	Walls	Mass (HC > 7 Btu/ft^2)	R-11.4 c.i.	EN6, 17, 20-21
		Metal building	R-13 + R-13	EN7, 17, 20-21
		Steel framed	R-13 + R-7.5 c.i.	EN8, 17, 20-21
		Wood framed and other	R-13 + R-3.8 c.i.	EN9, 17, 20-21
		Below-grade walls	R-7.5 c.i.	EN10, 17, 20-21
	Floors	Mass	R-10.4 c.i.	EN11, 17, 20-21
		Steel framed	R-30	EN12, 17, 20-21
		Wood framed and other	R-30	EN12, 17, 20-21
	Slabs	Unheated	No recommendation	EN17, 19-21
		Heated	R-10 for 36 in.	EN14, 17, 19-21
	Doors	Swinging	U-0.70	EN15, 20-21
		Non-swinging	U-0.50	EN16, 20-21
	Vertical Glazing	Window to wall ratio (WWR)	20% to 40% maximum	EN23, 36-37
		Thermal transmittance	U-0.42	EN25, 31
		Solar heat gain coefficient (SHGC)	N, S, E, W - 0.46 N only - 0.46	EN27-28
		Window orientation	$(A_N * SHGC_N + A_S * SHGC_S) > (A_E * SHGC_E + A_W * SHGC_W)$	A_x–Window area for orientation x EN26-32
		Exterior sun control (S, E, W only)	Projection factor 0.5	EN24, 28, 30, 36, 40, 42 DL5-6
	Skylights	Maximum percent of roof area	3%	DL5-7, DL8, DL13
		Thermal transmittance	U-0.69	DL7, DL8, DL13
		Solar heat gain coefficient (SHGC)	0.39	DL8, DL13
Lighting	Interior Lighting	Lighting power density (LPD)	0.9 W/ft^2	EL1-2, 4, 8, 10-16
		Light source (linear fluorescent)	90 mean lumens/watt	EL4, 9, 17
		Ballast	Electronic ballast	EL4
		Dimming controls for daylight harvesting for WWR 25% or higher	Dim fixtures within 12 ft of N/S window wall or within 8 ft of skylight edge	DL1, 9-11, EL6-7
		Occupancy controls	Auto-off all unoccupied rooms	DL2, EL5, 6
		Interior room surface reflectances	80%+ on ceilings, 70%+ on walls and vertical partitions	DL3-4, EL3
HVAC	HVAC	Air conditioner (0-65 KBtuh)	13.0 SEER	HV1- 2, 4, 6, 12, 16-17, 20
		Air conditioner (>65-135 KBtuh)	11.0 EER/11.4 IPLV	HV1- 2, 4, 6, 12, 16-17, 20
		Air conditioner (>135-240 KBtuh)	10.8 EER/11.2 IPLV	HV1- 2, 4, 6, 12, 16-17, 20
		Air conditioner (>240 KBtuh)	10.0 EER/10.4 IPLV	HV1- 2, 4, 6, 12, 16-17, 20
		Gas furnace (0-225 KBtuh - SP)	80% AFUE or E_t	HV1- 2, 6, 16, 20
		Gas furnace (0-225 KBtuh - Split)	90% AFUE or E_t	HV1- 2, 6, 16, 20
		Gas furnace (>225 KBtuh)	80% E_c	HV1- 2, 6, 16, 20
		Heat pump (0-65 KBtuh)	13.0 SEER/7.7 HSPF	HV1- 2, 4, 6, 12, 16-17, 20
		Heat pump (>65-135 KBtuh)	10.6 EER/11.0 IPLV/3.2 COP	HV1- 2, 4, 6, 12, 16-17, 20
		Heat pump (>135 KBtuh)	10.1 EER/11.0 IPLV/3.1 COP	HV1- 2, 4, 6, 12, 16-17, 20
	Economizer	Air conditioners & heat pumps - SP	Cooling capacity > 54 KBtuh	HV23
	Ventilation	Outdoor air damper	Motorized control	HV7-8
		Demand control	CO_2 sensors	HV7, 22
	Ducts	Friction rate	0.08 in. w.c./100 feet	HV9, 18
		Sealing	Seal class B	HV11
		Location	Interior only	HV9
		Insulation level	R-6	HV10
SWH	Service Water Heating	Gas storage	90% E_t	WH1-4
		Gas instantaneous	0.81 EF or 81% E_t	WH1-4
		Electric storage 12 kW	EF > 0.99 – 0.0012xVolume	WH1-4
		Pipe insulation (d<1½ in./ d≥1½ in.)	1 in./ 1½ in.	WH6

Note: If the table contains "No recommendation" for a component, the user must meet the more stringent of either Standard 90.1 or the local code requirements in order to reach the 30% savings target.

- Energy-saving recommendations for each climate zone on **single page**
- Tables color-coded to maps
- Prescriptive recommendations identify energy savings without costly calculations
- References to "how-to" section

Example Designs for Climate Zones

- Features real examples of advanced building energy designs
- Demonstrates flexibility offered in achieving advanced energy savings levels
- Selected from award winning designs by architects

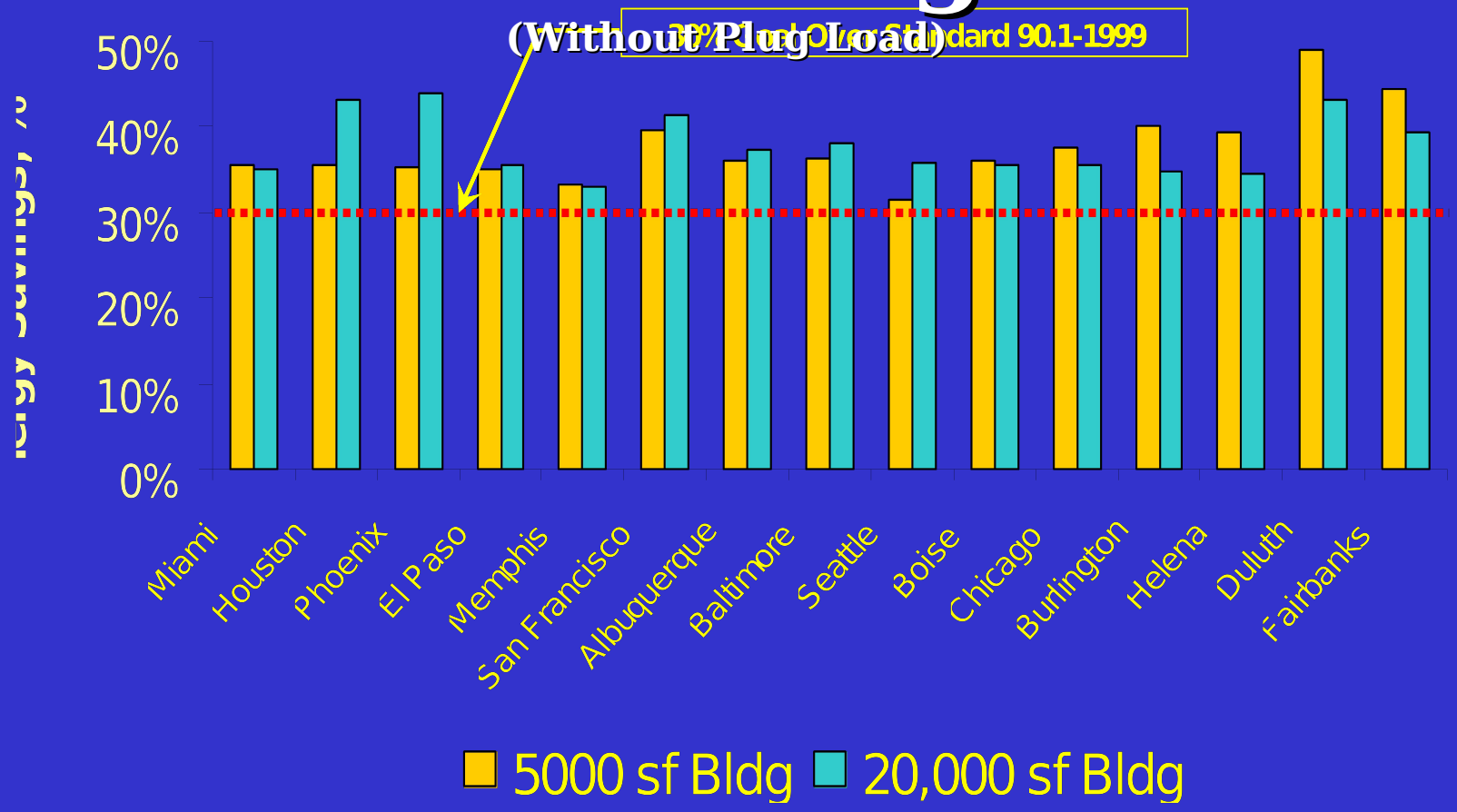
"How-To" Recommendations

- Gives good design practice – "rules-of-thumb" and "should consider"
- Envelope
  - Opaque envelope components
  - Vertical glazing
  - Window design guidelines
    - for thermal conditions
    - for daylighting
- Lighting
  - Daylighting and daylighting controls
  - Electric lighting design - interior and exterior

“How-To” Recommendations

- HVAC
  - Loads
  - Humidity control
  - Energy recovery
  - Equipment efficiency
  - Ventilation and exhaust air
  - Ductwork
- Service Water Heating
- Plug Loads
- Quality Assurance

Energy Savings of Advanced vs. Base Building



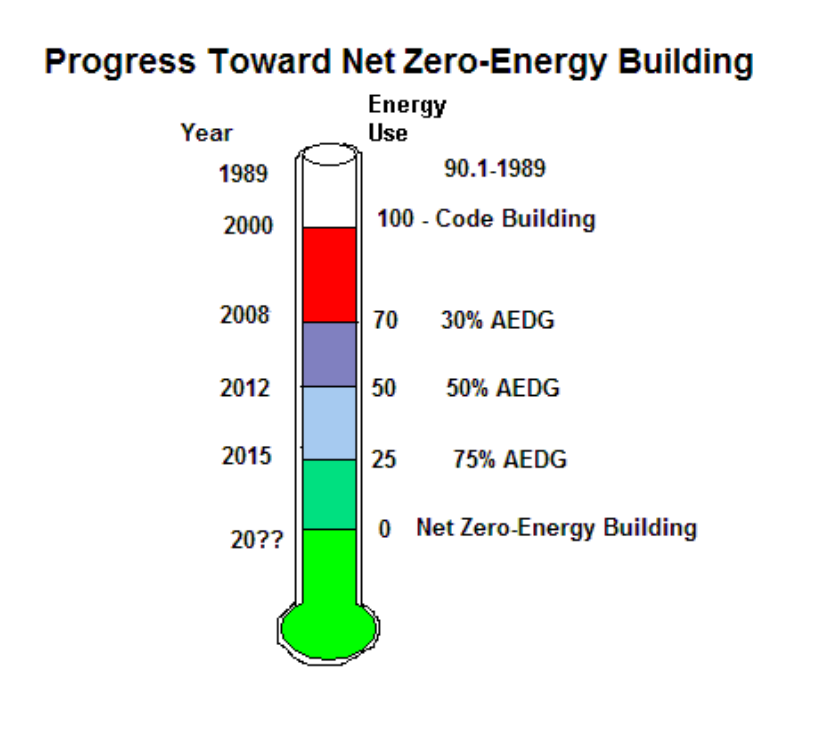
How Obtain?

- www.ashrae.org
- www.iesna.org
- www.aia.org

Where Do We Go From Here?

- Additional 30% guides proceeding or planned for other building types:
  - Small retail (began fall ’05)
  - K-12 Schools (start winter ’06)
  - Warehouses
  - Low-rise motel/hotel
  - Healthcare
  - Low-rise multifamily

Future Design Guides



- Target Net Zero-Energy Building
- Reference is a building designed to the energy standards in place at the turn of the millennium (e.g.. 90.1-1999)

Advanced Energy Design Guide For Small Retail Buildings

- ASHRAE, IESNA, AIA, USGBC
- 14 person Project Committee
- Began work in Oct. 2005
- 35% Concept Draft Completed Dec. 2005
- Three levels of review: 35%, 65%, 90%
- Content completion: June 2006

Advanced Energy Design Guide For Small Retail Buildings

- Audience: contractors, designers, developers, owners, tenants
- Address both owner and tenant build out requirements
- Lighting must maintain merchandising focus

Advanced Energy Design Guide For Small Retail Buildings

- Single story, <20K ft2
- Exclude “Big Box” retail, food service, point sources of heat or pollutants with high ventilation loads
- Unitary packaged HVAC equipment

Strip Mall Store 1

- Blockbuster Video
- Approximately 90+% of the lighting from a linear fluorescent system, remaining < 10% would be accent lighting
- Double bay module, 50 by 75 ft
- Ceiling height 11 ft

Strip Mall Store 2

- Hallmark Card shop
- Approximately 75% of the lighting is linear fluorescent and 25% is accent
- Single bay of strip mall, 25 by 75 ft
- Ceiling height 11 ft

Strip Mall Store 3

- Upscale women's clothing store
- 50% of lighting from CFL downlights and 50% from accent lighting
- Single bay of strip mall, 25 by 75 ft
- Ceiling height 11 ft

Stand-Alone Store

- JoAnn Fabrics store
- 50 ft x 100 ft - ceiling height 14 ft
- 70% merchandise, 20% storage with loading dock, 5% office, 5% other (restroom, workspace, breakroom)
- 100% linear fluorescent lighting

Conclusions

- Collaborating organizations are providing requested guidance on how to design, build and operate energy efficient buildings.

- AEDGs present *a way, but not the only way,* to build energy efficient buildings that use significantly less energy than those built to minimum code requirements